

**MULTI-DEVICE DISTRIBUTED DIGITAL VIDEO
RECORDING SYSTEMS AND METHODS**

BACKGROUND OF THE INVENTION

5 The present invention relates to the field of multi-media recording and playback. More specifically, the present invention relates to multi-device distributed digital video recording systems and methods.

10 Current digital video recorder (DVR) and personal versatile recorder (PVR) systems are limited by the number of tuners and the amount of storage space present on the PVR/DVR device. These limitations impede the user's ability to simultaneously record multiple programs and pause and fast-forward live television programming. The amount of storage space limits the number of programs that the user may save to his/her device.

 Further, current DVR systems lack the ability to add new tuners once the hardware is delivered to the consumer. The hard disk drives are also limited in size to what is installed in the device at manufacture.

15 It would be advantageous to provide a digital video recording system that is not limited by the number of tuners or amount of storage physically present at the recording device.

 The methods and apparatus of the present invention provide the foregoing and other advantages.

SUMMARY OF THE INVENTION

The present invention provides multi-device distributed digital video recording systems and methods. The present invention enables digital recording devices (e.g., a DVR, PVR, or the like) on a cable plant to share resources via the utilization of a command and control protocol and a content delivery mechanism.

In an example embodiment of the invention, a plurality of networked digital video recorders are provided. A requesting digital video recorder (DVR) on the network may be capable of broadcasting a request to a plurality of DVRs seeking resources of a dormant DVR. At least one dormant DVR on the network may be capable of providing a response to the requesting DVR indicating its availability of resources. The requesting DVR may then select a granting DVR from the dormant DVRs with available resources (i.e., those DVRs that responded to the request). A session may then be established between the requesting DVR and the granting DVR. Once the session is established, the resources of the granting DVR may be made available for use by the requesting DVR.

Corresponding methods and systems are provided in accordance with the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will hereinafter be described in conjunction with the appended drawing figures, wherein like numerals denote like elements, and:

Figure 1 shows an illustration of an example embodiment of the invention;

5 Figure 2 shows a further illustration of an example embodiment of the invention;

Figure 3 shows an additional illustration of an example embodiment of the invention;

and

Figure 4 shows a block diagram of an example digital video recorder in accordance with an example embodiment of the invention.

DETAILED DESCRIPTION

The ensuing detailed description provides preferred exemplary embodiments only, and is not intended to limit the scope, applicability, or configuration of the invention. Rather, the ensuing detailed description of the preferred exemplary embodiments will provide those skilled in the art with an enabling description for implementing an exemplary embodiment of the invention. It should be understood that various changes may be made in the function and arrangement of elements without departing from the spirit and scope of the invention as set forth in the appended claims.

The present invention provides multi-device distributed digital video recording systems and methods. The present invention enables digital recording devices (e.g., a DVR, PVR, or the like) on a cable plant to share resources via the utilization of a command and control protocol and a content delivery mechanism. The term DVR is used herein to mean any type of digital recording device currently known or to be developed in the future.

In an example embodiment of the invention as shown in Figures 1-3, a plurality of networked digital video recorders is provided. A requesting digital video recorder (DVR) on the network may be capable of broadcasting a request to a plurality of DVRs seeking resources of a dormant DVR, as shown in Figure 1. The broadcast may be via Internet Protocol, a telephone path, a proprietary path, or the like. At least one dormant DVR on the network may be capable of providing a response to the requesting DVR indicating its availability of resources, as shown in Figure 2. The requesting DVR may then select a granting DVR from the dormant DVRs with available resources (i.e., those DVRs that responded to the request), as shown in Figure 3. A session may then be established between the requesting DVR and the granting DVR. Once the session is established, the resources of the granting DVR may be made available for use by the requesting DVR.

Figure 4 shows an example embodiment of a digital video recorder (DVR) for use in a multi-device distributed digital video recording system in accordance with the present invention. The DVR may act as a requesting DVR, a dormant DVR with available resources, or a granting DVR. The DVR may include at least one tuner (e.g., in-band

tuner 102 and in-band tuner 104), at least one storage device 110, and a processor 112. The remaining components of DVR 100 are standard components that are well known in the art, and are not pertinent to the present invention.

Where the DVR 100 acts as a requesting DVR, the processor 112 may be enabled for
5 broadcasting a request to a plurality of networked DVRs seeking resources of a dormant DVR, receiving a response from at least one dormant DVR indicating availability of resources, selecting a granting DVR from the dormant DVRs with available resources, establishing a session with the granting DVR, and utilizing resources of the granting DVR, as discussed above in connection with Figures 1-3. Where the DVR is acting as a dormant DVR,
10 the processor may be enabled for receiving a broadcast request from a requesting DVR seeking available resources, responding to the requesting DVR regarding availability of resources, if resources are available and if selected by the requesting DVR, establishing a session with the requesting DVR, and providing resources for use by the requesting DVR, as discussed above in connection with Figures 1-3.

15 The resources may include at least one of a tuner (e.g., tuner 102 or tuner 104) and a storage device 110. Where the resources comprise a tuner 102, 104 of the granting DVR 20, control of that tuner may be turned over to the requesting DVR 10.

The requesting DVR 10 may request that the granting DVR 20 tune to a particular channel and record designated content from that channel. The granting DVR 20 may store the
20 designated content for use by the requesting DVR 10 (e.g., at storage device 110). If the granting DVR 20 does not have access to the particular channel, the granting DVR 20 may advise the requesting DVR 10 that access is not available. The requesting DVR 10 may then request access to the particular channel from the headend 30 on behalf of the granting DVR 20. For example, the requesting DVR 10 may request a conditional access system at the
25 headend 30 to grant temporary permission to the granting DVR 20. If a fee applies (e.g., for a pay-per-view event) the conditional access system may charge the fee to the requesting DVR 10 accordingly and provide temporary access to the granting DVR 20 to acquire the designated content.

The granting DVR 20 may tag the recorded designated content in storage device 110 as being owned by the requesting DVR 10. The granting DVR 20 may encrypt the recorded designated content with an encryption key known to the requesting DVR 10. The encrypted recorded designated content may be made available to the granting DVR 20. For example, the encrypted designated content may be made available to the granting DVR 20 for a fee. The fee may be discounted since the granting DVR 20 allowed its resources to be borrowed.

The requesting DVR 10 may request access to the stored designated content on the storage device 110 of the granting DVR 20. The stored designated content may then be uploaded from the granting DVR 20 to the requesting DVR 10. Alternatively, the stored designated content may be streamed from the granting DVR 20 to the requesting DVR 10. The requesting DVR 20 may control the presentation of the streamed designated content utilizing a command and control channel to send commands to the granting DVR 20. The commands may comprise at least one of play, stop, pause, fast forward, rewind, skip, jump, and the like.

After the designated content is acquired by the granting DVR 20, the granting and requesting DVRs may establish a schedule by which the granting DVR 20 either uploads the content to the requesting DVR 10 or streams the content to the requesting DVR 10 in accordance with a playback request.

A time limit may be imposed on how long the content may be stored on the granting DVR 20. Once the time limit passes without having the requesting DVR 10 retrieve the content, the content may be deleted from the storage device 110. In addition, if the storage device 110 of the granting DVR 20 is needed and the requesting DVR 10 does not have storage space for the content, the stored content may be transferred to another DVR 12 or to the headend 30 for storage.

Alternatively, the granting DVR 20 may automatically forward the stored designated content to a storage device 110 at the requesting DVR 10. The designated content may be forwarded via DOCSIS (Data Over Cable Service Interface Specification) provided both the requesting and granting devices are equipped with DOCSIS tuners 114.

The request for resources may be routed through a system operator at the headend 30. Multiple requests for identical designated content from multiple requesting DVRs 10 may then be handled by a single granting DVR 20.

There may be instances where a user will want to record on the user's DVR, but that
5 DVR is acting as a granting DVR 20 and is providing available resources, such as a tuner 102, 104 and/or a storage device 110 to a requesting DVR 10. In such cases, various options exist for handling the user's request to record: (1) the granting DVR 20 may request a third DVR 12 to finish the recording session; (2) the granting DVR 20 may check back with the requesting DVR 10 to see if its resources are now free to finish the recording session; or (3)
10 the granting DVR 20 may request that a third DVR 12 provide available resources to accommodate the user's request to record, using the methods described above.

When a user requests the DVR to tune to and/or record content and the DVR is functioning as a granting DVR 20, a pop-up notification may be provided advising that the DVR 20 is out of resources and asking whether the resources of another DVR 12 should be
15 requested. The pop-up notification may be generated by a software application running on the DVR processor 112. The user requests may be entered at user interface 116.

The system operator at the headend 30 may provide a credit or a discount to those user's that allow their DVRs to act as a granting DVR 20 and allow their resources to be borrowed. The discount or credit can be provided per session. For example, a pop-up window
20 may be generated each time a request has been received for available resources. The user can then accept or decline the request. Alternatively, the granting function can be switched on or off by the user at the DVR.

The system operator may also charge the requesting device for the right to borrow the resources of the granting DVR 20.

25 The granting DVR 20 may provide a menu of all content stored thereat to the requesting DVR 10, not just the designated content requested by the requesting DVR 10. Further, once a DVR stores content, it can be made available to other DVRs 12 via the network. For example, the headend 30 may provide a menu of all content stored on the DVRs 12 in the network. This content may be made available to any DVR in the network for a fee.

The present invention solves the problem of limited DVR resources by allowing a user to simultaneously record multiple programs by utilizing the resources of someone else's DVR. Thus, a dual-tuner DVR in this system is not limited to simultaneously recording of only 2 programs. The DVR can now record X number of programs, where X is the number of
5 DVRs on the cable plant that have the available resources to record the content.

It should now be appreciated that the present invention provides advantageous methods and apparatus for enabling distributed digital video recording.

Although the invention has been described in connection with various illustrated embodiments, numerous modifications and adaptations may be made thereto without
10 departing from the spirit and scope of the invention as set forth in the claims.